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**TITLE:** HIGH ENERGY, CINE RADIOGRAPHIC EXPERIMENT

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## HIGH ENERGY, CINE RADIOGRAPHIC EXPERIMENT

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A cine radiographic technique is being developed by using an inert rocket motor to simulate a burning rocket motor. If the development effort progresses to success, we hope to be able to radiographically visualize propellant grain burning surfaces and thereby determine velocity of burn as well as to image any abnormal conditions during the burn that would otherwise be obscured by flame, smoke, or the rocket motor case.

The work differs from similar, previous work in several particulars.

1. The rocket motors to be cine radiographed are of a much larger size, therefore requiring:
  - a. much higher x-ray energy and intensity, perhaps 10 MeV x-rays at dose rates of at least 1000 R per minute at a meter,
  - b. information gathering is desired at higher rates than normally available TV frame rates, thus high speed camera techniques are being employed up to 120 frames per second, and
  - c. the duration of image collection may be as long as several minutes, thus the total number of frames may approximate 5000.

The development work has used a nondestructive testing linear accelerator, normally used for conventional, industrial radiography. This machine was particularly appropriate since it would accept an external trigger signal.

Precollimation to reduce extraneous, scattered radiation was employed in the form of a depleted uranium, cylindrical collimator.

Conversion of x-rays to light was achieved with fluorescent intensifying screens with

The images from the fluorescent screen required amplification which was provided in this experiment by a three stage intensifier operating at a maximum light gain of 320 000 with a decay time of about 3 ms. The phosphor for this component was a broad response, Type P-20.

The principal camera used was a Mitchell 35-mm, pin registered, variable-speed framing camera. Operating parameters included a 50-mm lens working at f/2.7 and a magnification of 1:3 and Kodak Double X Negative Film. The Mitchell camera has the ability to generate pulses that could be used to trigger the linear accelerator. Signals from the camera were fed to a Datapulse 101 Pulse Generator that drove a Hewlett Packard Model 214A Pulse Generator that in turn triggered the linear accelerator.

Radiographic contrast results were relatively poor. A visualization of 14% incremental thickness of propellant equivalent material was achieved.

System resolution was determined by a resolution gauge comprising variably spaced, parallel steel plates, and was determined to be 3.2 mm. A technique was used whereby the original image was scanned by a microdensitometer and the digitized data then computer enhanced. The manipulated data was then played back and the visual display recorded. This improved image gave a system resolution of 1.6 mm.